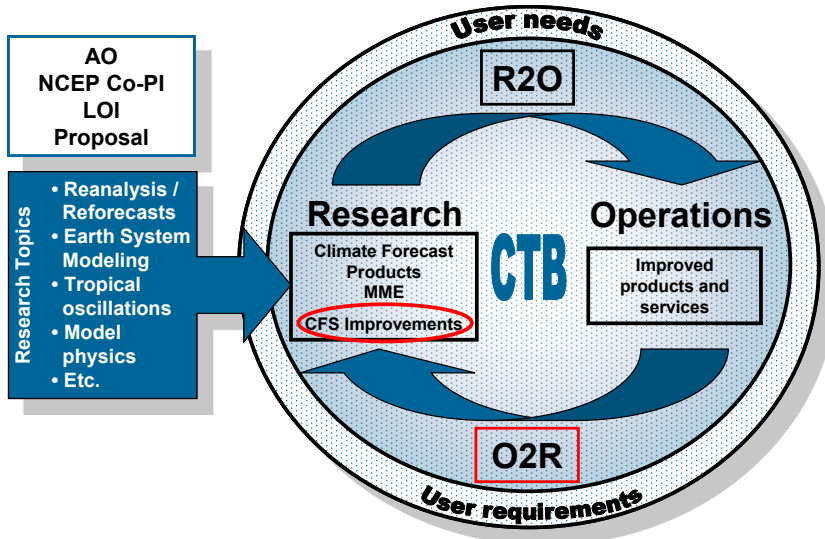


Overview

Climate Test bed (CTB)

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NCEP Climate Test Bed

Mission

To accelerate the transition of scientific advances from the climate research community to improved NOAA climate forecast products and services.

- Joint NCEP-CPO facility @ NCEP
- CTB Science Advisor Board (SAB)
- Established in 2005
- Serves as conduit between the operational, academic and research communities

- CTB embraces *the R2O and O2R paradigms*
- *Grants Program sponsored by Climate Program Office*
- **CTB emphasizes three science activities**
 - *CFS improvements*
 - *Multi-model ensembles*
 - *Climate forecast products*
- Bi-weekly CTB management meeting
- CTB Monthly Seminar Series

Climate Test Bed

Past Funded Projects

- **FY06**
 - Using Initial tendency errors to reduce systematic errors, identify model errors, and construct stochastic parameterizations (DeSol)
 - Development of neural network emulations of model physics components for improving the computational performance of the NCEP seasonal climate forecasts (Fox-Rabinovitz)
 - The Ocean Component of the NCEP ENSO CFS (McPhaden/Xue/Behringer)
- **FY07**
 - System-wide advancement of user-centric climate forecast products (Hartmann/O'Lenic)
- **FY08**
 - Recalibrating and Combining Ensemble Predictions (Goddard et al)
 - Probabilistic forecasts of extreme events and weather hazards over the United States (Jones/Gottschalck)
 - Enabling the Transition of CPC Products to GIS Format (Doty/Silva/Halpert)
 - Generation and Evaluation of Long-Term Retrospective Forecasts with NCEP Climate Forecast System: Predictability of ENSO and Drought (Cane/Wang/Xue)
 - Multi-Model Ensemble Climate Prediction with CCSM and CFS (Kirtman/van den Dool)
 - Development of an Extended and Long-range Precipitation Prediction System over the Pacific Islands (Annamalai/Kumar)
 - New Tools for North American Drought Prediction (Lyon/Kumar)

Climate Test Bed Currently Funded Projects

- **FY09**

- CFS Stratosphere Improvement, Perlwitz, Long, Alpert & Iredell
- Development of Subseasonal Ensemble Forecast Techniques, Schubert et al.
- A GOES Thermal-based Drought Early Warning Index For NIDIS, Anderson, Mo, et al
- Multi-model Ensemble Reanalysis System (MERS) Using the 4D-Local Ensemble Transform Kalman Filter (4D-LETKF), Ide, Kalnay, Miyoshi & Wang

- **FY10**

- Incorporating Scale and Predictability Information in Multi-model Ensemble Climate Predictions, DelSole, Tippett & van den Dool
- Multi-Model Ensemble Forecast of MJO, Wang & Waliser,
- Enhancing operational drought monitoring and prediction products through synthesis of N-LDAS and CPPA research results, Wood & Lettenmaier
- Improved Extended Range Prediction through a Bayesian Approach Exploiting the Enhanced Predictability Offered by the Madden-Julian Oscillation. Xie, Johnson, L'Heureux, Collins & Gottschalk
- Seasonal Prediction for Ecosystems and Carbon Cycle Using NCEP/CFS and a Dynamic Vegetation Mode, Zeng, Kalnay & Kumar
- CPT for Improving the Representation of the Stratocumulus to Cumulus Transition in Climate Models, Bretherton, Mechoso, Park & Teixeira

- **FY11**

- National Multi-Model Ensemble (NMME) Prediction System – Phase I

CTB Priority (1):

Improving Climate Forecast Tools/Products

Goal

To provide reliable climate forecast products that are responsive to the needs of users and incorporate state-of-the-art science and research

CTB Funded Activities

- **Drought and NIDIS**
 - New tool for drought prediction (FY08)
 - Drought monitoring and prediction products using NLDAS and CPPA results (FY10)
 - Drought Early Warning Index using satellite data (FY09)
 - Participating MAPP Drought Task Force
- **Forecast Tools, Assessment and Improvement**
 - Precipitation Prediction System over the Pacific Islands (FY08)
 - Probabilistic Forecasts of Extreme Events and Weather Hazards (FY08)
 - Seasonal Prediction for Ecosystems and Carbon Cycle (FY10)
 - Enabling the Transition of CPC Products to GIS Format (FY08)



Potential New Area: CTB Regional Projects

Background/Motivation

- Climate science has advanced in research world, but not in regional operations
- Regional centers want to use CPC seasonal forecasts for their regional operational, but need more info
- Current CPC-RISA Program is inactive

Proposed activities

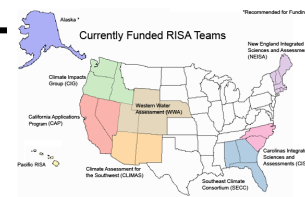
- Co-develop and test customer-tailored prediction tools and techniques with engagement of regional operational centers and regional decision makers
 - Apply CFS, NMME and other official CPC forecast tools for regional forecasts and applications, in support CBRFC testbed and NIDIS
- Testing and transfer of techniques from one region to another
- Strengthen current CPC-RISA Program

CPC-RISA Program

RISA	Contacts	Areas of Collaboration
Southeast Climate Consortium (SECC)	Muthuvel Chelliah (CPC) Jim Jones, Keith Ingram, Jim O'Brien	Downscaling CPC Outlooks, Regional ENSO Impacts; Crop Yield Forecasting; Applications of high resolution GCM,CFS hindcasts.
Western Water Assessment (WWA)	Michelle L'Heureux (CPC) Andrea Ray	Intraseasonal forecasts and applications; Decision support related to drought mitigation and response; user feedback to enhance CPC products.
Climate Assessments for the Southwest (CLIMAS)	Ed O'Lenic (CPC) Holly Hartmann	Improve users' ability to access and interact with, and make decisions based upon CPC outlooks.
Alaska Center for Climate Assessment and Policy (ACCAP)	Jon Gottschalck (CPC) Sarah Fleisher Trainor	Development and improved utilization of storminess related products, aid Alaska's drought / fire related challenges through better application of CPC official outlooks and the use of new precipitation databases.
Pacific Climate Information System (PaCIS)	Luke He (CPC) Eileen Shea, Jim Weyman	Pacific Rainfall Atlas; Climate Teleconferences and User Training, Research for Improving Climate Service and Forecasts for the Pacific region.
California Application Program (CAP)	Kingtse Mo (CPC) Dan Cayan, John Roads	Soil moisture analyses from 4 NLDASs and regional reanalysis, CFS-based drought forecasts, MME applications to SI forecasts, week 1, week 2 E, P, soil moisture relationships from NLDAS.
University of Washington Center for Science in the Earth System (CSES)	Doug LeComte (CPC) Dennis Lettenmaier	Enhancements to U.W. surface water monitor, Improved tools for Drought Monitor and Drought Outlook.

Goal: to meet RISA-customer needs for climate forecast products

Activities: exchanges via CPC & RISA focal points; workplans tailored to customer needs.



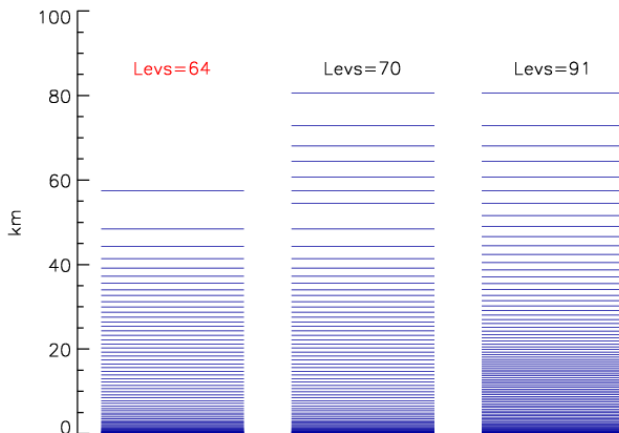
CTB Priority (2):

CFS Evaluation and Improvements

- To accelerate evaluation of and improvements to the operational Climate Forecast System (CFS) and to enhance its use as a skillful tool in providing NCEP's climate predictions and applications

CFS Stratosphere Improvement (Perlwitz, Long, Alpert & Iredell, FY09)

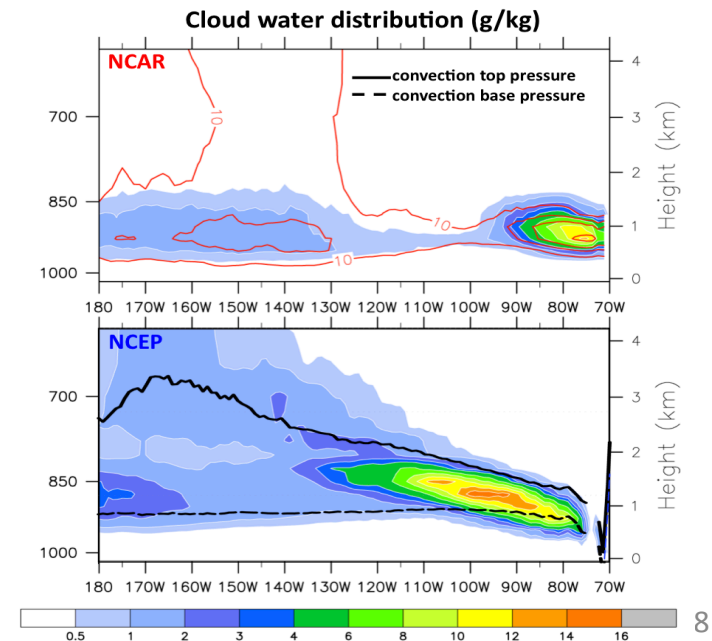
Results with raised model top



- The L70 model seems to perform better than the L64 model (control run).
- The jet position in the L70 model is more similar to the reanalysis than the L64 model.

NCEP Climate Process Team on Stratocumulus to Cumulus Transition (Bretherton, Pan, et al, FY10)

NCEP/NCAR diagnostics of cloud transition



CTB Recent Efforts in CFS Development

1. Organized **CFSv3 Planning Meeting** in August, 2011

The meeting summary with recommendations can be viewed in the CTB web site

2. Developed a draft **NCEP Climate Modeling Strategy**

- Based on the discussions and recommendations from the CFSv3 Planning Meeting
- The Strategy will provide a way forward the CFSv3 development
- The Strategy document is under discussion

3. Organized **CFSv2 Evaluation Workshop**

CFSv2 Evaluation Workshop

April 30 – May 1, 2011

- **Received over 120 registrations, ~ 60 abstracts**
- **Objectives:**
 - 1) Document improvement from CFSv1 to CFSv2
 - 2) Identify model biases and deficiencies in CFSv3
 - 3) Identify research directions for the development of CFSv3
- **Expected Outcomes**

A white paper on the near-term research priorities for CFSv3 development

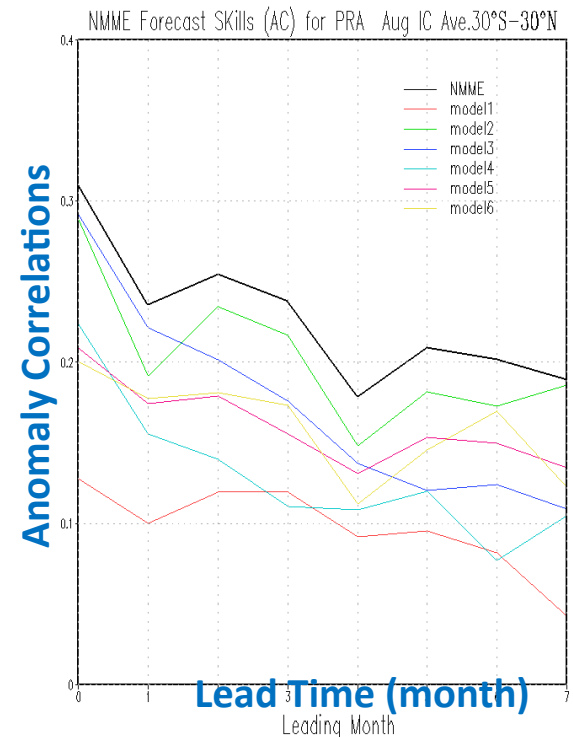
CTB Priority (3): Multi-Model Ensembles

Goal: A multi model ensemble prediction system that leverages the best national and international models for improved predictions on intraseasonal-to-interannual time scales

CTB Currently Funded Activities:

- 6 projects on MME consolidation and verification research during FY08-10
- In FY11, Phase I **National Multi-Model Ensemble (NMME)** is funded

Phase II NMME proposal to CPO is under review



NMME precipitation forecast Skills compared to individual models:

- August initial condition
- Based on 28 year hindcast
- 30S-30N averaged
- Black lines show the NMME skill

Motivation for National Multi-Model Ensemble (NMME)

- MME has a potential to improve ISI prediction
 - MME is a practical approach to quantifying forecast uncertainty due to model formulation
 - Large ensembles sample uncertainty due to initial conditions
 - Multi-Model approaches are multi-institutional, potentially bringing additional resources to the effort
- CTB has supported many MME research projects
- EUROSIP (international MME) is beneficial to operational forecasts, but data is not open to the research and user communities

US NMME Phase I

- **CTB NMME Workshops February 18, April 8, 2011**
 - Establish Collaboration within US
 - Protocol for Experimental Real-time Multi-Model Prediction
- **Hindcast data available via IRI Data Library**
- **Became Real-Time in August 2011**
 - Adhering to NCEP Operational Schedule

NMME Partners - Phase I

- University of Miami – RSMAS
- Nation Center for Atmospheric Research (NCAR)
- Center for Ocean-Land-Atmosphere Studies (COLA)
- International Research Institute (IRI)
- University of Colorado – CIRES
- NASA – GMAO
- NOAA/NCEP (EMC and CPC)
- NOAA/GFDL
- Princeton University
- Canadian Meteorological Centre is participating although not a formal partner in the proposal

NMME – Phase II

(FY2012-2013)

Main Goal: A more “purposeful” MME Experiment with improved models and an optimal experimental design to address key research questions

Tasks and Research Questions:

- **Continue Experimental Real-Time Predictions**
- **Enhance Current NMME Capabilities with model upgrades**
Model Improvements: GFDL-CM2.5 (20 km AGCM), NCAR (CCSM4, CESM1)
- **Assess Forecast Quality**
Consolidation techniques
Drought Assessment and Prediction: soil moisture, runoff, evaporation
- **Sub-Seasonal Assessment**
Forecast Protocols
- **Improved Data Distribution**
Under Discussion with NCAR

A Joint NMME and WGSIP (WCRP Working Group on Seasonal-Interannual Prediction) Workshop will be held in January 2013

NMME Data Archive

Phase-I data is available now:

- Monthly mean variables for SST, Temp, Precip (hindcast and real time forecast) for 30-year hindcasts and real time forecast from all participating models
- NMME hindcast data (digital) Available at <http://iridl.ldeo.columbia.edu/SOURCES/.Models/.NMME/>
or google: NCEP CTB, and click “Phase-I NMME Project data is now available”
- Graphical Output Available From NOAA/NCEP/CPC at <http://origin.cpc.ncep.noaa.gov/products/people/wd51yf/NMME/>

Phase-II data:

- Will contain both monthly and daily data
 - Useful for intra-seasonal predictability study
- The current plan is for NCAR to archive the Phase-II data

Benefits of NMME

A Purposeful Design: All Models follow the same protocol

Data (hindcasts and forecasts) are available to the community – a great research resource with the potential to be the equivalent of CMIP5 but for ISI prediction

Targeted predictability/prediction research questions that will be addressed by this NMME experiment and a great opportunity for the broader research community

Although led by NOAA, the NMME experiment shaping out to be a truly interagency/multi institution effort (more resources, eyes and minds to the problem)

Although experimental, real-time NMME forecasts are already in use by NCEP operational forecasters, along with EUROSIP.

The NMME system and the NCEP NAEFS system (for up to week 2 weather forecast) together will potentially provide seamless weather and climate forecasts for days, weeks, months, seasons ahead.

Summary

- **CTB is aimed at accelerating transitioning science advances to improved NOAA climate operations.**
- **CTB is jointly sponsored by NCEP and Climate Program Office (CPO)**
 - The CTB grants program sponsored by CPO/MAPP Program
 - NCEP provides personnel and computer
- **CTB current science priorities**
 - 1) CFS evaluations and improvements*
 - 2) Multi-model ensembles*
 - 3) Climate forecast tools and products*
- **CTB Monthly Seminar Series**